

Service Management Apparatus for Managing Service
Information for Services Present in Network System and
Apparatus for Instructing Service Management Apparatus

5 BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a network system for providing various services dispersed on plural apparatus, and more particularly to a directory server 10 for accumulating and managing information on the various services present on such network system and providing the client with information on the registered services.

Related Background Art

15 Conventionally there is being actively developed a document processing system of dispersed type in which apparatuses of single function for example an input apparatus such as an image scanner, a digital camera or a facsimile receiver and an output apparatus such as a 20 printer or a facsimile transmitter are mutually connected by a network, and which is capable of providing the client with complex functions, obtained by combining the functions of such single-functioned apparatus (for example data input function, data output 25 function, and input and output of data stored in a secondary storage device (network attached storage)).

Also in so-called multi function product (MFP), in

which the functions of plural single-functioned apparatuses are united in a single casing, there is also being actively developed a document processing system of dispersed type capable of realizing various 5 complex functions by selectively combining one or some of such single functions with those of other apparatuses through a network.

As a programming model for facilitating the function providing over the information processing 10 apparatuses dispersed in the network, there is already well known a remote procedure call (RPC) or a dispersed object technology. Such dispersed object technology is an expansion of the object-oriented software model to a dispersed system, and enables, by a procedure 15 equivalent to that of calling an operation of a network node from the same node, to call an operation of another network node.

Also in document processing including document input and document output, the dispersed object 20 technology is expected to achieve flexible linking of plural functions. Systems based on the dispersed object technology and aiming also at applications other than the dispersed information processing such as pure calculations are being proposed, for example, in Jini 25 which is an application of Java by the Sun (Stanford University Network) and in CORBA (Common Object Request Broker Architecture & Specifications) by the OMG

(Object Management Group).

If the various apparatus for document processing connected to the network can be controlled by the dispersed object technology, it will become easily 5 possible to describe a flexible client application interchangeably combining various apparatus providing objects based on a predetermined interface. it will also become possible to described a client application capable of dynamically inquiring the interface for 10 operating an object, or dynamically downloading a stub object (or a proxy object), for concealing the communication with a server object in a remote location for providing the actual service, thereby accommodating a change in the control interface resulting for example 15 from the addition of the apparatuses.

In a system in which the client is dynamically bound with the dispersed services at the execution (dynamic binding) thereby utilizing the services of the dispersed objects, there is utilized a directory server 20 (name server, registry server, lookup server etc.) storing the information of the available services, for enabling the client to locate the desired service. In a system in which plural services or clients are dispersed, a part of the services may become 25 temporarily unavailable because of a failure of the apparatus providing the service or a breakage of the network connecting with the service. It is therefore

necessary to execute appropriate maintenance on the information of the services registered in such directory server thereby not introducing the unavailable service to the client.

5 In case each service is shut down and deactivated in proper manner, the cancellation of registration may be instructed in advance to the directory server from such service. However, such renewal of the information of the directory server from the registered service is
10 not possible in case of a system crash or in case the reachability through the network is lost. Also certain apparatus such as the document processing apparatus has to be prepare for a situation where the power supply is suddenly cut off by the user, and, also in such case,
15 there cannot be properly maintained the directory information based on the notice from the apparatus or the service.

Also a dispersed object system such as the Jini based on Java adopts a lease model in which the client
20 obtains the right of using various services with a predetermined term. For example, in a service of registering the service information of the client in the lookup server, the utilization of such lookup server is also leased for a certain term, and the
25 registration is canceled unless the continuation of use is applied for before the expiration of the lease term. In order to accommodate such situation, the Jini system

realizes the maintenance of the registered information in preparation for the unnotified cancellation of the services.

5 SUMMARY OF THE INVENTION

However, the above-described conventional technologies have been associated with the following drawbacks since the maintenance and renewal of the information registered in the directory server is based 10 on the periodical lease renewal process executed by the service which registers the information.

More specifically, on each service registered in the directory server, the client can know that such service is functioning at such a level allowing recent 15 lease renewal, but cannot know whether the function to be achieved by such service is proper in quality.

Particularly in case plural services of similar kindes are registered for arbitrary selection, the client naturally wishes to judge a service which is 20 best in performance or in reliability, but the conventional directory server has not provided the information for such judgment.

Also in the services provided for example by a document processing apparatus, the practical quality of 25 the provided service may be affected by the dynamic state change in the apparatus, but the conventional directory server has not provided the client with a

standard for selecting the optimum service among the plural services having such characteristics. Such change in the practical quality of the service by the dynamic state change can be exemplified, for example in 5 a printer, by a color printer which is functioning as a monochromatic printer because of the exhaustion of the color toners or color inks, or by a printer designed to be capable of printing on an A3-sized sheet and provided with a cassette for holding the A3-sized 10 sheets but lacking A3-sized sheets therein.

Also in the conventional dispersed object system, the lease term is often determined relatively long, because the overhead cost for the renewal process of the lease term becomes relatively large if the lease 15 term is determined short, so that the maintenance of the registered information relying solely on the lease renewal is often unable to follow the dynamic state of the system.

Also in a conventional system of a redundant configuration in which a plurality of equivalent services are provided in order to improve usability, the client has to judge the service to be used in place for the failed service and is therefore required a complex procedure.

25 In consideration of the foregoing, a first object of the present invention is to provide a directory server capable of providing the client not only with

the information notified from each service but also the information indicating the level of quality of the service objectively evaluated by the actual trial use of the service.

5 The present invention also allows to eliminate the registration of the service not only in case of expiration of the lease term but also in case the service is canceled without notification.

10 The present invention further allows, in a system including a plurality of equivalent services, the client to automatically select a proxy service replacing a failed service, thereby enabling the client to enjoy the improved usability by the redundant configuration without complicating the process of the 15 client.

15 The present invention further realizes simple dispersion of the loads (load balancing) based on the redundant configuration, thereby realizing a redundant configuration capable of responding to the practical 20 loss in the quality of the provided service, for example by switching to a proxy service in response to a dynamic state change of the apparatus such as exhaustion of toner or paper.

25 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view showing the network configuration in embodiments of the present invention;

Fig. 2 is a block diagram showing the configuration of an image input/output apparatus adapted to the dispersed object environment in embodiments of the present invention;

5 Fig. 3 is a cross-sectional view showing the configuration of a reader unit and a printer unit of the image input/output apparatus adapted to the dispersed object environment in the embodiments of the present invention;

10 Fig. 4 is a block diagram showing the configuration of a core unit of the image input/output apparatus adapted to the dispersed object environment in the embodiments of the present invention;

15 Fig. 5 is a block diagram showing the job control for an image input job and an image output job in the embodiments of the present invention;

Fig. 6 is a schematic view showing examples of the configuration of sessions in the embodiments of the present invention;

20 Fig. 7 is a block diagram showing the configuration of a client computer in the embodiments of the present invention;

Fig. 8 is a block diagram showing the configuration of a lookup server in the embodiments of the present invention;

25 Figs. 9A and 9B are schematic views showing conceptually the configuration of a service object in

first to fourth embodiments of the present invention;

Fig. 10 is a schematic view showing the process flow in which a peripheral equipment registers a service proxy object in the lookup server in the first to third embodiment of the present invention;

Fig. 11 is a schematic view showing the process flow in which a peripheral equipment of the first to third embodiment of the present invention obtains a service proxy object from the lookup server;

Fig. 12 is a memory map showing the configuration of a management table in the lookup server in the embodiments of the present invention;

Fig. 13 is a flow chart showing the sequence of a service evaluating process executed by the lookup server of the first embodiment of the present invention;

Fig. 14 is a flow chart showing the sequence of a service registration renewing process executed by the lookup server of the first embodiment of the present invention;

Fig. 15 is a flow chart showing the sequence of a service evaluating process executed by the lookup server of the second embodiment of the present invention;

Fig. 16 is a flow chart showing the sequence of a service evaluating process executed by the lookup server of the third embodiment of the present

invention;

Fig. 17 is a schematic view showing the software configuration of an image input apparatus adapted to an environment of two dispersed objects constituting a 5 pair and mutually monitoring each other;

Fig. 18 is a flow chart showing the sequence of a service evaluating process executed by an image input/output apparatus adapted to the dispersed object environment in a fourth embodiment of the present 10 invention;

Fig. 19 is a flow chart showing the sequence of a service evaluating process executed by an image input/output apparatus adapted to the dispersed object environment in a fifth embodiment of the present 15 invention;

Fig. 20 is a flow chart showing the sequence of a response process to a request for obtaining a service proxy object, executed by a lookup server the fifth embodiment of the present invention;

20 Fig. 21 is a flow chart showing the sequence of a service evaluating process executed by an image input/output apparatus adapted to the dispersed object environment in a sixth embodiment of the present 25 invention; and

Fig. 22 is a flow chart showing the sequence of a service evaluating process executed by an image input/output apparatus adapted to the dispersed object

environment in a seventh embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Now the present invention will be clarified in detail by preferred embodiments, with reference to the accompanying drawings.

Common configuration and function

10 Prior to the description of the embodiments of the present invention, there will be explained the configuration of the system and apparatus used in common in the embodiments of the present invention and the function of the apparatus.

15 Fig. 1 shows a network system in embodiments of the present invention. As shown in Fig. 1, a network 11 is connected to two image input/output apparatus 12-1, 12-2 adapted to a dispersed object environment such as Jini of Java or CORBA, a client computer 13 and a lookup server computer 14.

20 The dispersed object environment-adapted image input/output apparatus 12-1, 12-2 can transfer respective data through the network 11. Also the client computer 13 can remote control the dispersed object environment-adapted image input/output apparatus 12-1, 12-2. In the lookup server 14, there is registered a service proxy object, together with attribute information thereof, required for the remote

control of the dispersed object environment-adapted image input/output apparatus 12-1, 12-2 (hereinafter collectively represented as 12) from the client computer 13.

5 Fig. 2 shows an example of the configuration of the dispersed object environment-adapted image input/output apparatus 12 shown in Fig. 1. As shown in Fig. 2, the dispersed object environment-adapted image input/output apparatus 12 is provided with a reader unit 1, a printer unit 2 and an image input/output control unit 3. The reader unit 1 reads the image of an original and outputs image data corresponding to the original image to the image input/output control unit 3. The printer unit 2 records, on a recording sheet, 10 an image corresponding to the image data from the image input/output control unit 3. The image input/output control unit 3 is connected to the reader unit 1 and the printer unit 2, and is composed of a facsimile unit 4, a storage unit 5, a computer interface unit 7, a RIP 15 (raster image processor) unit 8, an operation unit 9, a core unit 10 etc.

20

The facsimile unit 4 expands compressed image data received through a telephone line, transfers the expanded image data to the core unit 10, also compresses image data transferred from the core unit 10 25 and transmits the compressed image data through a telephone line. The received or transmitted image data

can be temporarily stored in a hard disk 6 connected to the storage unit 5.

The storage unit 5, connected with a hard disk 6, compresses the image data transferred from the core 5 unit 10 and stores such image data in the hard disk 6 together with an ID (identification) number for searching the image data. Also the storage unit 5 searches the compressed image data stored in the hard disk 6 based on the code data transferred through the 10 core unit 10, reads and expands the searched compressed image data and transfers the expanded image data to the core unit 10.

The computer interface unit 7 constitutes an interface between the network 11 and the core unit 10, 15 and executes data exchange with the client computer 13 and other dispersed object environment-adapted image input/output apparatus 12.

The RIP unit 8 develops the code data (PDL: page description language) transferred from the network 11 20 and representing an image into image data that can be recorded in the printer unit 2.

The operation unit 9 is provided with a touch panel display and hard keys (not shown), and constitutes a user interface for instructing and 25 setting operations to the dispersed object environment-adapted image input/output apparatus 12.

The core unit 10 controls, as will be explained

later in more details, the data flow among the reader unit 1, the printer unit 2, the facsimile unit 4, the storage unit 5, the computer interface unit 7, the RIP unit 8 and the operation unit 9.

5 Fig. 3 is a cross-sectional view showing the configuration of the reader unit 1 and the printer unit 2 shown in Fig. 2. An original document feeder 101 of the reader unit 1 feeds the originals one by one from the top onto a platen glass 102, and discharges the 10 original therefrom after the original reading operation. When an original is conveyed onto the platen glass 102, a lamp 103 is turned on and the movement of a scanner unit 104 is started to execute scanning exposure of the original. The light reflected 15 from the original is guided by mirrors 105, 106, 107 and a lens 108 to a CCD (charge coupled device) 109, whereby the image of the scanned original is read by the CCD 109. Image data outputted from the CCD 109 are transferred, after predetermined processing, to the 20 core unit 3 of the image input/output control unit 3.

A laser driver 221 of the printer unit 2 drives and causes a laser emission unit 201 to emit a laser light corresponding to the image data from the core unit 10 of the image input/output control unit 3. The 25 laser light irradiates a photosensitive drum 202 to form thereon a latent image corresponding to such laser light. Developer is deposited by a developing unit 203

on the latent image on the photosensitive drum 202. A recording sheet is fed from a cassette 204 or 205 to a transfer unit 206 in a timing synchronized with the start of laser light irradiation and the developer 5 deposited on the photosensitive drum 202 is transferred onto the recording sheet.

The recording sheet bearing the developer is conveyed to a fixing unit 207, in which the developer is fixed to the recording sheet by heat and pressure in 10 the fixing unit 207. After passing the fixing unit 207, the recording sheet is discharged by discharge rollers 208 to a finisher 220, which sorts the recording sheets by collecting the discharged recording sheets in a bundle and staples thus sorted recording 15 sheets.

When two-side recording is selected, the recording sheet is once discharged to the discharge rollers 208, and is then guided to a re-feeding path 210 by a flapper 209 and by reversing the rotating direction of 20 the discharge rollers 208. The recording sheet guided to the re-feeding path 210 is fed again to the transfer unit 206 at the above-described timing.

Fig. 4 shows an example of the configuration of the core unit 10 shown in Fig. 2. As shown in Fig. 4, 25 the core unit 10 is composed of an interface (I/F) unit 120, a data processing unit 121, an interface 122, a CPU (central processing unit) 130, a memory 124 etc.

The image data from the reader unit 1 are transferred through the interface 122 to the data processing unit 121, which executes image processing such as image rotation and magnification change, and compression and 5 expansion of the image data, and is provided therein with a page memory (not shown) corresponding to image data of plural pages of A4/letter size. The image data transferred from the reader unit 1 to the data processing unit 121 are temporarily stored in the page 10 memory, then compressed and transferred to the storage unit 5 through the interface 120.

Also the code data (PDL) representing an image entered through the computer interface unit 7 are transferred through the interface 120 to the data processing unit 120, then transferred to the RIP unit 8 for development into image data. Thus developed image data are transferred to the data processing unit 121 for temporary storage in the aforementioned page memory (not shown), then compressed and transferred through 20 the interface 120 to the storage unit 5.

The image data from the facsimile unit 4 are transferred to the data processing unit 121 for temporary storage in the aforementioned page memory (not shown), then compressed and transferred through 25 the interface 120 to the storage unit 5.

The image data from the storage unit 5 are transferred to the data processing unit 121, then

expanded and temporarily stored in the aforementioned page memory (not shown), and transferred through the interface unit 120 to the printer unit 2, the facsimile unit 4 and/or the computer interface unit 7.

5 The storage unit 5 executes input and output of the image and non-image data through the computer interface unit 7, thereby providing an external apparatus with data storing function.

10 The image data, after entry into the data processing unit 121 and temporary storage in the internal page memory (not shown) but prior to the transfer to the storage unit 5, may also be transferred to the printer unit 2, the facsimile unit 4 or the computer interface unit 7 by the switching of an internal selector (not shown).

15 The CPU 123 controls the above-mentioned functions according to a control program stored in a memory 124 and a control command transferred from the operation unit 9. The memory 124 is used also as a work area for the CPU 123.

20 Thus the dispersed object environment-adapted image input/output apparatus 12 can execute a complex process involving functions of original image reading, image printing, image transmission and reception, image storage, data input into and output from computers (13, 14 in Fig. 1)) principally by the core unit 10 and through the data processing unit 121 thereof and the

storage unit 5.

In the following there will be explained, with reference to Fig. 5, the job control in the dispersed object environment-adapted image input/output apparatus 5 12 of the present embodiment. Fig. 5 shows a logical unit of the job control. A unit of the job control is input and output processes for a group of image data containing plural pages. Thus, the controlled job is mainly classified into an image input job and an image 10 output job.

The image input job can be further classified into an image input job 411 for recording in succession the image data, read by the reader unit 1, into the storage unit 5, an image input job 412 for recording in succession the image data, developed by the RIP unit 8, into the storage unit 5, an image input job 413 for recording in succession the image data, received by the facsimile unit 4, into the storage unit 5, and an image input job 414 for recording in succession the image 20 data, entered from the computer interface unit 7, into the storage unit 5.

Furthermore, the dispersed object environment-adapted image input/output apparatus 12 of the present embodiment can provide a function of utilizing the 25 storage unit 5 for the accumulation of non-image data, and the image input jobs 411 and 414 can also handle the non-image data.

Also the image output job can be classified into an image output job 401 for outputting in succession the image data, read from the storage unit 5, to the printer unit 2, an image output unit 403 for outputting in succession the image data, read from the storage unit 5, to the facsimile unit 4, and an image output job 404 for outputting in succession the image data, read from the storage unit 5, to the computer interface unit 7.

Fig. 6 shows examples of a unit (hereinafter called session) formed by combining the above-mentioned plural jobs. A copy session 501 is controlled by a combination of the image input job 411 and the image output job 401. A PDL print session 502 is controlled by a combination of the image input job 412 and the image output job 401. A facsimile reception session 503 is controlled by a combination of the image input job 413 and the image output job 401. A printer session 504 is controlled by a combination of the image input job 414 and the image output job 401. A facsimile transmission session 505 is controlled by a combination of the image input job 411 and the image output job 403. A scan session 506 is controlled by a combination of the image input job 411 and the image output job 404. A facsimile modem reception session 507 is controlled by a combination of the image input job 413 and the image output job 404. A facsimile

modem transmission session 508 is controlled by a combination of the image input job 414 and the image output job 403.

A session is a control unit containing at least a 5 job, and a session may be constituted for example by the image input job 412, by the image output job 401, or by a combination of the image input job 412, the image output job 401 and the image output job 403.

Fig. 7 shows an example of the system 10 configuration of a host computer to be employed as the client computer 13 shown in Fig. 1. The client computer 13 is featured by the algorithm of the software functioning thereon, of which behavior will be explained later.

Referring to Fig. 6, a host computer 2400 is 15 provided with a CPU 2401 for executing document processing mixedly containing graphics, images, characters and tables (including table calculations) based for example on a document processing program 20 stored in a program ROM contained in a ROM 2403, and comprehensively controls various devices connected to a system bus 2413. The program ROM contained in the ROM 2403 stores for example a control program for the CPU 2401. A RAM 2402 functions as a main memory and a work 25 area for the CPU 2401.

A keyboard controller (KBC) 2405 controls key input from a keyboard 2409 and a pointing device (not

shown). A CRT controller (CRTC) 2406 controls the display on a CRT display 2410.

A disk controller (DKC) 2407 controls access to an external storage device 2411 such as a hard disk (HD) 5 or a floppy disk (FD) for storing a boot program, various applications, font data, user files, editing files etc. A network interface (I/F) 2408 executes a communication control process with other host computers or with various input/output devices through the 10 network 11.

The CPU 2401 executes development (rasterization) of the display information for example set on the RAM 2402 into outline font on the RAM, thereby enabling WYSIWYG (what you see is what you get). Also the CPU 15 2401 opens various windows based on a command designated for example by a mouse cursor (not shown) on the CRT 2410 and executes various data processings.

Fig. 8 shows an example of the system configuration of a host computer employed similarly to 20 the lookup server computer 14. The lookup server computer 14 can have the well known hardware configuration of a general-purpose computer, and the featuring function is achieved by the algorithm of the software functioning thereon. For example, such 25 software can function on the hardware of the dispersed object environment-adapted image input/output apparatus 12, and, in such case, the dispersed object

environment-adapted image input/output apparatus 12 serves also as the lookup server 14. The behavior of the software will be explained later.

Referring to Fig. 8, a host computer 2500 is provided with a CPU 2501 for executing processes based for example on a program stored in a program ROM contained in a ROM 2503, and comprehensively controls various devices connected to a system bus 2513. A RAM 2502 functions as a main memory and a work area for the CPU 2501. A keyboard controller (KBC) 2505 controls key input from a keyboard 2509 and a pointing device (not shown). A CRT controller (CRTC) 2506 controls the display on a CRT display 2510. A disk controller (DKC) 2507 controls access to an external storage device 2511 such as a hard disk (HD) or a floppy disk (FD) for storing a boot program, various applications, font data, user files, editing files etc. A network interface 2508 executes a communication control process with other host computers or with various input/output devices through the network 11.

In the following there will be briefly explained the dispersed object system of the present embodiment. In the present embodiment, there is employed a dispersed object system similar to the configuration 25 Jini based on Java.

The memory 124 in the core unit 10 shown in Fig. 4 stores a plurality of service objects, each

constituting a software unit for utilizing, as a service, the function of the apparatus realized by each session shown in Fig. 6. Such service objects are constituted respectively corresponding to the services 5 provided by the dispersed object environment-adapted image input/output apparatus 12, such as the PDL printing, image printing, image scanning, facsimile transmission, facsimile reception, data accumulation, apparatus management, job management etc.

10 The service object is a software configuration called object in the known object-oriented technology, and is provided with an interface for providing the client with a function and a substance for realizing the function, requested through the interface, by the 15 control of the apparatus. In particular, the service object in the present embodiment is an object in the known dispersed object technology, and is so constructed that the service is available by calling the above-mentioned interface not only from a client 20 software provided in the local memory space of the apparatus but also from a client software provided in a memory space of a remote external apparatus (for example the client computer 13) through the network 11.

In the following there will be explained 25 embodiments of the present invention.

First embodiment

At first there will be explained the schematic

configuration of the service object for providing the client with the services, in first to third embodiments of the present invention. Figs. 9A and 9B conceptually show the configuration of a data accumulation service object, which is one of the service objects.

Fig. 9A shows a general object-oriented system in which a client software 702 utilizes an interface 705 from the space of the memory 124 in the apparatus.

A data accumulation service object 703 provides an interface 705 which the client uses for utilizing the storage unit 5 in the apparatus as a secondary storage device. The interface 705 is provided with an interface defined by a group of operations (operations 1, 2, 3, 4, ...) provided by the known general file system, such as "open" for generating a file to be stored in the storage unit 5 or obtaining a descriptor for accessing to an already generated file, "close" for declaring the completion of access to the file, "read" for reading data from a file, "write" for writing data into a file, "unlink" for deleting a file etc.

When each operation defined by the interface 705 is called, there is activated an apparatus control software 704 providing a substance corresponding to the interface 705. As a result, the CPU 123 controls the storage unit 5 so as to realize a predetermined function corresponding to each operation.

The foregoing describes the behavior of the

general object-oriented system in which the client
software utilizes the interface from the space of the
internal memory 124 of the apparatus. Also, as shown
in Fig. 9B, the service object of the dispersed object
5 system of the present embodiment provides a service
interface to a client software in the memory space of a
remote apparatus, through the dispersed linkage of a
service proxy object 713, provided in the memory space
of another remote apparatus (for example the client
10 computer 13) and a service mount object 723 provided
in the internal memory space of the apparatus.

A data accumulation service proxy object 713
provides an interface 715 which the client uses for
utilizing the storage unit 5 in the apparatus as a
15 secondary storage device. The interface 715 is
provided with an interface same as explained in the
foregoing, including for example "open" for generating
a file to be stored in the storage unit 5 or obtaining
a descriptor for accessing to an already generated
20 file, "close" for declaring the completion of access to
the file, "read" for reading data from a file, "write"
for writing data into a file, "unlink" for deleting a
file etc.

When each operation defined by the interface 715
25 is called by the client in the memory space of the
remote apparatus, there is activated a software for
transferring such operation calling request to the

apparatus through the network 11. According to such software, the CPU (for example 2401) of the remote apparatus encodes the identifier for identifying the requested operation and the data structure transferred 5 as an argument to the request, into a byte train that can be transmitted through the network 11. Such encoding process is called marshalling or serializing, and can be realized by certain known technologies.

Then the CPU of the remote apparatus transmits the 10 encoded byte train to the apparatus 12 through the network 11. Such communication is executed by a protocol such as IIOP of OMG (Object-oriented Management Group) or RMI of SUN (Stanford University Network).

15 In the local memory space of the apparatus 12, a software generally called an object request broker 722 constantly monitors the reception of request data from the network 11. Upon receiving the byte train of the request data from the network 11, the object request broker 722 decodes the byte train to restore the 20 original object operation call and the data structure to be transferred thereto as the argument, thereby calling a corresponding operation of the service mount object 723. Thus, there is activated a control 25 software providing the mount corresponding to the interface 725. As a result, the CCPU 123 control the storage unit 5 thereby realizing the predetermined

function corresponding to each operation.

In the foregoing description, the client software 712 need not be programmed in consideration of a fact that the service mount object 723 realizing the service 5 of the apparatus 12 exists in another memory space present across the network 11. Stated differently, since the encoding process for the operation call and the communication process through the network are concealed in the service proxy object 713, the client 10 software 712 can easily utilize the service in the same manner as the service object is present in its own memory space. Such equivalence of the network to the programmer of the client software 712 is one of the important advantages of the dispersed object 15 environment.

Also the encoding and communication process executed by the service proxy object 713 in the foregoing description is based on a predetermined encoding algorithm and a predetermined communication 20 protocol. Stated differently, these processes can be strictly defined, independently from the interface which is variable depending on each service object. More specifically, it is possible to mechanically generate the program of the service proxy object 713 by 25 a compiler provided by the dispersed object environment (generally called an IDL compiler) by reading a description strictly defining the interface of the

service as data and executing interpretation and conversion processes. Another important advantage of the dispersed object environment is that the programmer constructing the system can easily obtain the program of 5 the service proxy object 713, utilizing the IDL (integrated data oriented language) as a tool.

In the following, there will be explained the function of a system consisting of the client computer 13, the lookup server 14 and the dispersed object 10 environment-adapted image input/output apparatus 12, with emphasis on the function of the lookup server 14.

Fig. 10 shows the process of uploading the service proxy object from the dispersed object environment-adapted image input/output apparatus 12 of 15 a peripheral equipment to the lookup server 14. At first, the dispersed object environment-adapted image input/output apparatus 12, at the timing of connection to the network 11, emits a broadcast packet inquiring whether the lookup server 14 is present to the network 20 11 (step S01).

Receiving the broadcast packet, the lookup server 14 informs the presence thereof to the dispersed object environment-adapted image input/output apparatus 12 (step S02).

25 Then the dispersed object environment-adapted image input/output apparatus 12 registers a driver 617 in the discovered lookup server 14. More specifically,

the dispersed object environment-adapted image input/output apparatus 12-1, 12-2 connected to the network 11 respectively register the service proxy objects 617-1, 617-2 in the lookup server 14 (step 5 S03).

In the lookup server 14, the registered service proxy object is managed together with attribute information such as the date of registration, service name (name of peripheral equipment), service specifications (service content), service location etc. as shown in Fig. 12. For the kinds of the registered attribute information, there is defined a standard scheme by the Jini community for each service category such as printer or storage. Also independent information specific to the service may also be registered as an attribute in the lookup server 14. The lookup server 14 is so constructed as to reply the attributes of the registered service in response to the inquiry from the client software.

Fig. 11 shows a process of downloading a service proxy object from the lookup server 14 to the client computer 13. In case the client computer 13 utilizes the dispersed object environment-adapted image input/output apparatus 12, the client computer 13 at first checks the service proxy objects present in the lookup server 14 corresponding to the services (step S1). Then the client computer 13 downloads a desired

service proxy object from the lookup server 14 (step S2), and communicates with the dispersed object environment-adapted image input/output apparatus 12 providing the desired service (step S3).

5 More specifically, in case of a request such as "receiving a print service" or "receiving a scanning service", the client computer 13 confirms the registered services by looking at a management table 1801 of the lookup server 14 as shown in Fig. 12 and
10 downloads the desired service from the lookup server 14.

15 The dispersed object system of the present embodiment adopts a model in which the use right of a service is leased to the client for a predetermined term. More specifically, the dispersed object environment-adapted image input/output apparatus 12 registers its presence in the lookup server 14 utilizing the service thereof, and an effective term is defined also on such registration. The registration
20 expires after a certain period unless the registration is periodically repeated, and the mechanism of such expiration allows to avoid the drawback that the ineffective information continues to be registered in the lookup server 14 in case the server constituting
25 the client thereof loses its function for example by a failure in the system.

Fig. 13 is a flow chart showing a service

evaluating process executed by the CPU 2501 of the
lookup server 14 in the first embodiment of the present
invention. The CPU 2501 evaluates the registered
information by periodically repeating the service
5 evaluating process, utilizing a timer process based on
a timer (not shown).

For the purpose of simplicity, the lookup server
14 of the present embodiment is assumed as a lookup
server exclusively registering the information of a
10 storage service for providing the client with a
temporary secondary storage function. The process of
the present flow chart is executed parallel to other
processes of the lookup server, by a time-shared
process of the CPU 2501 of the lookup server 14. The
15 process of the present flow chart is executed, in the
lookup server 14, as a pseudo client utilizing the
lookup server 14 itself and the services registered
therein.

When the service evaluating process is started, a
20 step S11 selects a service from the list of the
services registered in the management table 1801 as
shown in Fig. 12.

The present service evaluating process is
terminated if a next step S12 identifies that no
25 service is registered in the management table 1801 or
that all the registered services have been evaluated.
Otherwise, a step S13 obtains the service proxy object

of the selected registered service. The service proxy object is downloaded in the same manner as in the process of the ordinary client, as explained in relation to Fig. 11.

5 Then a step S14 obtains the current time from a timer (not shown) to start the measurement of the time required for the process. Then a step S15 calls an "open" operation from the interface 715 of the service proxy object 713 shown in Fig. 9B in the same manner as 10 executed by the ordinary client, thereby opening a file. Then a step S16 calls a "write" operation of the service proxy object 713 and writes test data, prepared in advance, in the file. A next step S17 calls a "read" operation of the service proxy object 713 and 15 reads the data written into the file in the preceding step S16. Then a step S18 calls a "close" operation of the service proxy object 713, thereby closing the file.

Then a step S19 obtains the current time from the aforementioned timer (not shown), and obtains the time 20 required for the serial process from the difference between the time obtained in the step S14 and the current time. A step S20 adds, to the management table 1801 shown in Fig. 12, the required time (hereinafter 25 represented as response time) obtained in the preceding step S19 as one of the registered attributes for the contemplated service.

The sequence then returns to the step S11 for

repeating the above-described process for each of all the registered services.

The response time, obtained as the result of evaluation and added as the attribute information to 5 the management table 1801 in the course of the service evaluating process can be replied, similarly to other attributes in the management table 1801, in response to the inquiry from the client.

In the present first embodiment, as explained in 10 the foregoing, the lookup server 14 tries, as a client, each of the services registered therein and can transmits the information of the response time to the client. As a result, based on the response time 15 information, the client can estimate the performance of such service and that of the network 11 for reaching such service and can thus select the optimum service based on the objective evaluation by the lookup server 14.

The management table 1801 may contain not only the 20 recent response time but also the history of past several times or the combination of a best value and a worst value. Also the response time information may be suitably normalized to provide the client with an index of the service performance ranked for example as A, B, 25 C, . . .

The lookup server 14 in the first embodiment of the present invention executes, in addition to the

trial and evaluation of the service by the service evaluating process shown in Fig. 13 and the process of replying the result of evaluation to the client, a renewal process for the registered information based on 5 the result of evaluation.

Fig. 14 is a flow chart showing the procedure of a service registration renewal process executed by the CPU 2501 of the lookup server 14 in the first embodiment of the present invention. The CPU 2501 10 renews the registered information by periodically repeating the service registration renewal process, based on a timer process utilizing a timer (not shown). The process of the present flow chart is executed in parallel to other processes of the lookup server by a 15 time-shared process of the CPU 2501 of the lookup server 14.

When the service registration renewal process is started, a step S21 selects a service from the list of the services registered in the management table 1801 as 20 shown in Fig. 12.

The present service registration renewal process is terminated in case a next step S22 identifies that no service is registered in the management table 1801 or that all the registered services have been renewed. 25 Otherwise, a step S23 reads the registration time attribute (time of latest lease) of the service from the management table 1801. A next step S24

discriminates whether the difference between the current time and the registration time exceeds the lease term, and, if not, the sequence proceeds to a step S25, but, if the lease term is exceeded, the
5 sequence proceeds to a step S27.

A step S25 reads, from the management table 1801, the response time attribute of the service obtained by the recent service evaluating process. A step S26 compares the obtained response time with a
10 predetermined reference, and, if the performance is equal to or higher than the reference, the sequence returns to the step S21 to repeat the foregoing process to all the registered services. If the performance is less than the reference, the sequence proceeds to a
15 step S27.

A step S27 deletes the registration of the service from the management table 1801. Thereafter the sequence returns to the step S21 to repeat the foregoing process to all the registered services.

20 In the present first embodiment, as explained in the foregoing, the lookup server 14 tries, as a client, each of the services registered therein and forcedly deletes the registration of the service in case the evaluation based on the response time information does
25 not meet a certain standard. In this manner the lookup server 14 can make an effort to guarantee the quality in performance of the registered service. As a result,

the client can select an appropriate service, expecting
that the services registered in the lookup server 14
are of higher quality in average, in comparison with
the services registered in another lookup server not
5 executing such process.

Second embodiment

Fig. 15 is a flow chart showing the sequence of a
service evaluating process executed by the CPU 2501 of
the lookup server 14 in a second embodiment of the
10 present invention. The CPU 2501 renews the registered
information by periodically repeating the service
evaluating process, utilizing a timer process based on
a timer (not shown).

For the purpose of simplicity, the lookup server
15 14 of the present embodiment is assumed as a lookup
server exclusively registering the information of a
storage service for providing the client with a
temporary secondary storage function. The process of
the present flow chart is executed parallel to other
20 processes of the lookup server, by a time-shared
process of the CPU 2501 of the lookup server 14. The
process of the present flow chart is executed, in the
lookup server 14, as a pseudo client utilizing the
lookup server 14 itself and the services registered
25 therein.

When the service evaluating process is started, a
step S31 selects a service from the list of the

services registered in the management table 1801 as shown in Fig. 12. The present service evaluating process is terminated if a next step S32 identifies that no service is registered in the management table 1801 or that all the registered services have been evaluated. Otherwise, a step S33 obtains the service proxy object 713 of the selected registered service. The service proxy object 713 is downloaded in the same manner as in the process of the ordinary client.

10 Then a step S34 calls an "open" operation from the interface 715 of the service proxy object 713 in the same manner as executed by the ordinary client, thereby opening a file. Then a step S35 calls a "write" operation of the service proxy object 713 and writes 15 test data, prepared in advance, in the file. A next step S36 calls a "read" operation of the service proxy object 713 and reads the data written into the file in the preceding step S35. Then a step S37 calls a "close" operation of the service proxy object 713, 20 thereby closing the file.

Then a step S38 compares the data written in the step S35 with the data read in the step S36, and, if there is a difference therebetween, an error is identified and an increment is made on a count 25 indicating the level of abnormality (hereinafter represented as abnormality count) in an internal counter (not shown). Also in case the result of

operation called in each of the foregoing steps indicates an abnormal result such as busy, the number of such abnormal result is added to the aforementioned abnormal count. If all the steps are completed in 5 normal manner, an increment is made on a count indicating the level of normality (hereinafter represented as normality count) in an internal counter (not shown).

The sequence then returns to the step S31 for 10 repeating the above-described process for each of all the registered services.

The values of the aforementioned abnormality count and normality count, obtained as the result of evaluation and added as the attribute information to 15 the management table 1801 in the course of the service evaluating process, can be replied, similarly to other attributes in the management table 1801, in response to the inquiry from the client.

In the present embodiment, the presence of error 20 is discriminated by limiting the service to storage and executing an access test to the file, but, in more general manner, the presence of error may be discriminated by calling an operation for executing a "self test" operation or the like provided in all the 25 services.

In the present second embodiment, as explained in the foregoing, the lookup server 14 tries, as a client,

each of the services registered therein and can transmits the information on the presence or absence of error to the client. As a result, based on such error information, the client can estimate the reliability of 5 such service and that of the network 11 for reaching such service and can thus select the optimum service based on the objective evaluation by the lookup server 14.

It is also possible to execute maintenance of the 10 registered information based on the reliability of the service, by combining the lookup server 14 of the present embodiment with a service registration renewal process similar to that shown in Fig. 14. In such configuration of the present embodiment, the lookup 15 server 14 tries, as a client, each of the services registered therein and forcedly deletes the registration of the service in case the evaluation based on the presence or absence of the error does not meet a certain standard. In this manner the lookup 20 server 14 can make an effort to guarantee the quality in reliability of the registered service. As a result, the client can select an appropriate service, expecting that the services registered in the lookup server 14 25 are of higher quality in average, in comparison with the services registered in another lookup server not executing such process.

Third embodiment

Fig. 16 is a flow chart showing the sequence of a service evaluating process executed by the CPU 2501 of the lookup server 14 in a third embodiment of the present invention. The CPU 2501 renews the registered 5 information by periodically repeating the service evaluating process, utilizing a timer process based on a timer (not shown).

For the purpose of simplicity, the lookup server 14 of the present embodiment is assumed as a lookup 10 server exclusively registering the information of a printing service. The process of the present flow chart is executed parallel to other processes of the lookup server, by a time-shared process of the CPU 2501 of the lookup server 14. The process of the present 15 flow chart is executed, in the lookup server 14, as a pseudo client utilizing the lookup server 14 itself and the services registered therein.

When the service evaluating process is started, a step S41 selects a service from the list of the 20 services registered in the management table 1801 as shown in Fig. 12. The present service evaluating process is terminated if a next step S42 identifies that no service is registered in the management table 1801 or that all the registered services have been 25 evaluated. Otherwise, a step S43 obtains the service proxy object 713 of the selected registered service. The service proxy object 713 is downloaded in the same

manner as in the process of the ordinary client.

Then a step S44 calls a state obtaining operation from the interface 715 of the service proxy object 713 in the same manner as executed by the ordinary client, 5 thereby obtaining the dynamic state information of the printer unit 2. Then a step S45 evaluates the state information obtained in the preceding step S44 according to a predetermined algorithm. This algorithm is defined by an evaluating function of a wide sense, 10 for example providing a significant negative point for example if the color toners or inks are exhausted in a color printer, and a negative point for example if a large-sized printing sheet is exhausted in a large-sized printer.

15 Then a step S46 adds, to the management table 1801, the results of evaluation (for example the negative point) as an attribute of the service. The step S46 may appropriate reform the latest state information of the apparatus obtained in the step S44 20 and add such information as one of the registered attributes of the service to the management table 1801. The sequence then returns to the step S41 for repeating the above-described process for each of all the registered services.

25 The result of the above-described evaluation, added as the attribute information to the management table 1801 in the course of the service evaluating

process, can be replied, similarly to other attributes in the management table 1801, in response to the inquiry from the client.

In the present third embodiment, as explained in 5 the foregoing, the lookup server 14 tries, as a client, each of the services registered therein and can transmits the evaluation based on the dynamic state (and dynamic state information itself) to the client. As a result, the client can know the important state 10 information of the service and the evaluation thereof prior to the selection of a service and the downloading of the proxy object thereof, and can thus select the optimum service.

It is also possible to execute maintenance of the 15 registered information based on the reliability of the service, by combining the lookup server 14 of the present embodiment with a service registration renewal process similar to that shown in Fig. 14. In such configuration of the present embodiment, the lookup 20 server 14 tries, as a client, each of the services registered therein and forcedly deletes the registration of the service in case the evaluation based on the reliability does not meet a certain standard. In this manner the lookup server 14 can make 25 an effort to guarantee the quality of the registered service, based on the dynamic state thereof. As a result, the client can select an appropriate service,

expecting that the services registered in the lookup server 14 are of higher quality in average, in comparison with the services registered in another lookup server not executing such process.

5 **Fourth embodiment**

Fig. 17 schematically shows a software configuration in fourth to seventh embodiments of the present invention to be explained in the following, wherein the dispersed object environment-adapted image input/output apparatuses 12-1 and 12-2 connected to the network 11 constitute a pair in which each functions as the client of the services of the other and tries such services of the other. In Fig. 17, components equivalent to those in Figs. 9A and 9B are represented by corresponding numbers.

As shown in Fig. 17, the dispersed object environment-adapted image input/output apparatuses 12-1, 12-2 have similar software configurations in which the object request broker 722 of either apparatus is connected with the service proxy object 713 of the other apparatus through the network 11.

Fig. 18 is a flow chart showing the sequence of a service evaluating process, executed by each of the CPU's 123 of the dispersed object environment-adapted image input/output apparatuses 12-1, 12-2 of the fourth embodiment of the present invention, on the services of the other. The CPU 123 evaluates the quality of the

service of the other apparatus by periodically repeating the present service evaluating process by a timer process based on a timer (not shown).

For the purpose of simplicity, the present 5 embodiment deals, among the services provided by the dispersed object environment-adapted image input/output apparatuses 12, with the storage service of providing the client with the temporary secondary storage function. The process of the present flow chart is 10 executed, by a time-shared process of the CPU 123 of the dispersed object environment-adapted image input/output apparatus 12, parallel to other processes required in the apparatus. The process of the present flow chart is executed as a pseudo client in the 15 dispersed object environment-adapted image input/output apparatus 12, utilizing the services of the other image input/output apparatus 12.

When the service evaluating process is started, a 20 step S51 obtains the service proxy object 713 of the other from the lookup server 14. The service proxy object 713 is downloaded in the same manner as in the process of the ordinary client.

Then a step S53 calls a "write" operation of the 25 service proxy object 713 and writes test data, prepared in advance, in the file. A next step S54 calls a "read" operation of the service proxy object 713 and reads the data written into the file in the preceding

step S53. Then a step S55 calls a "close" operation of the service proxy object, thereby closing the file.

Then a step S56 compares the data written into the file in the foregoing step S53 with the data read in 5 the step S54, and, if there is a difference therebetween, the sequence proceeds to a step S57. Also in case the result of operation in each of the foregoing steps indicates an abnormal value such as busy or expiration of response time, the sequence 10 proceeds to a step S57. On the other hand, if all the steps are completed in normal manner, a step S56 terminates the present service evaluating process.

A step S57 calls a forced service registration deletin g process of the lookup server 14 so as to 15 delete the registration of the service of the other, on which the abnormality is observed, from the lookup server 14. The present service evaluating process is thereafter terminated.

In the present embodiment, the presence of error 20 is discriminated by limiting the service to storage 5 and executing an access test to the file, but, in more general manner, the presence of error may be discriminated by calling an operation for executing a "self test" operation or the like provided in all the 25 services.

In the present fourth embodiment, as explained in the foregoing, each of the plural dispersed object

environment-adapted image input/output apparatuses 12 mutually tries the services of the other and, in case of the detection of an abnormality, the deletion of the registration of the abnormal service can be promptly 5 notified to the lookup server 14. It is rendered possible to shorten the time of continued registration of an ineffective service in the lookup server 14 and to reduce the danger that the client tries the utilization of an ineffective service.

10 Fifth embodiment

Fig. 19 is a flow chart showing the sequence of a service evaluating process in a fifth embodiment of the present invention, executed respectively by each of the CPU's 123 of the dispersed object environment-adapted 15 image input/output apparatuses 12, on the service of the other of paired apparatuses. The CPU 123 evaluates the quality of the service of the other apparatus by periodically repeating the present service evaluating process by a timer process based on a timer (not 20 shown).

For the purpose of simplicity, the present embodiment deals, among the services provided by the dispersed object environment-adapted image input/output apparatuses 12, with the storage service of providing 25 the client with the temporary secondary storage function. The process of the present flow chart is executed, by a time-shared process of the CPU 123 of

the dispersed object environment-adapted image input/output apparatus 12, parallel to other processes required in the apparatus. The process of the present flow chart is executed as a pseudo client in the 5 dispersed object environment-adapted image input/output apparatus 12, utilizing the services of the other image input/output apparatus 12.

When the service evaluating process is started, a step S61 obtains the service proxy object 713 of the 10 other from the lookup server 14. The service proxy object 713 is downloaded in the same manner as in the process of the ordinary client. Then a step S62 calls an "open" operation from the interface of the service proxy object 713 in the same manner as executed by the 15 ordinary client, thereby opening a file.

Then a step S63 calls a "write" operation of the service proxy object 713 and writes test data, prepared in advance, in the file. A next step S64 calls a "read" operation of the service proxy object 713 and 20 reads the data written into the file in the preceding step S63. Then a step S65 calls a "close" operation of the service proxy object 713, thereby closing the file.

Then a step S66 compares the data written into the file in the foregoing step S63 with the data read in 25 the step S64, and, if there is a difference therebetween, the sequence proceeds to a step S67.

Also in case the result of operation in each of the

foregoing steps indicates an abnormal value such as busy or expiration of response time, the sequence proceeds to a step S67.

On the other hand, if all the steps are completed 5 in normal manner, a step S66 terminates the present service evaluating process.

A step S67 calls a service transfer instructing process of the lookup server 14 so as to introduce a service provided by the own apparatus as a proxy for 10 the service of the other, in which the abnormality is observed, and the present service evaluating process is thereafter terminated.

When the above-mentioned service transfer instructing operation is called, the lookup server 14 15 sets the identification information of the designated transfer service, as a substitute attribute in the record of the corresponding service in the management table 1801 shown in Fig. 12.

In the present embodiment, the presence of error 20 is discriminated by limiting the service to the storage unit 5 and executing an access test to the file, but, in more general manner, the presence of error may be discriminated by calling an operation for executing a "self test" operation or the like provided in all the 25 services.

Fig. 20 is a flow chart showing the sequence of a response process to a request for obtaining the service

proxy object, to be executed by the CPU 2501 of the lookup server 14 in the fifth embodiment of the present invention, at the reception from the client of a request for downloading of the service proxy object

5 713.

At first, a step S71 searches, in the management table 1801 shown in Fig. 12, a record corresponding to the service designated by the client. A next step S72 discriminates whether a substitute attribute is set in 10 the searched record, and, if not, the sequence proceeds to a step S73, but, if set, the sequence proceeds to a step S74.

A step S73 transmits the service proxy object of the designated service to the client. A step S74 15 transmits, to the client, the service proxy object of a substitute service designated by the identification information set in the substitute attribute.

In the present fifth embodiment, as explained in the foregoing, each of the plural dispersed object environment-adapted image input/output apparatuses 12 20 mutually tries the services of the other and, in case of the detection of an abnormality, the lookup server 14 can be promptly so instructed as to transfer the request of the client for an abnormal service to the 25 service of the normal side. It is thus rendered possible to shorten the time of continued registration of an ineffective service in the lookup server 14 and

to reduce the danger that the client tries to utilize an ineffective service. Also the client wishing to utilize the ineffective service is automatically given an equivalent substitute service, whereby the usability 5 of such service can be improved.

Sixth embodiment

Fig. 21 is a flow chart showing the sequence of a service evaluating process in a sixth embodiment of the present invention, executed respectively by each of the 10 CPU's 123 of the dispersed object environment-adapted image input/output apparatuses 12, on the service of the other of paired apparatuses. The CPU 123 evaluates the quality of the service of the other apparatus by periodically repeating the present service evaluating process by a timer process based on a timer (not 15 shown).

For the purpose of simplicity, the present embodiment deals, among the services provided by the dispersed object environment-adapted image input/output apparatuses 12, with the storage service of providing 20 the client with the temporary secondary storage function. The process of the present flow chart is executed, by a time-shared process of the CPU 123 of the dispersed object environment-adapted image input/output apparatus 12, parallel to other processes 25 required in the apparatus. The process of the present flow chart is executed as a pseudo client in the

dispersed object environment-adapted image input/output apparatus 12, utilizing the services of the other image input/output apparatus 12.

When the service evaluating process is started, a
5 step S81 obtains the service proxy object 713 of the other from the lookup server 14. The service proxy object 713 is downloaded in the same manner as in the process of the ordinary client. Then a step S82 obtains the current time from a timer (not shown) thereby
10 starting to measure the time required for the following process. Then a step S83 calls an "open" operation from the interface 715 of the service proxy object 713 in the same manner as executed by the ordinary client, thereby opening a file.

15 Then a step S84 calls a "write" operation of the service proxy object 713 and writes test data, prepared in advance, in the file. A next step S85 calls a "read" operation of the service proxy object 713 and reads the data written into the file in the preceding
20 step S84. Then a step S86 calls a "close" operation of the service proxy object 713, thereby closing the file.

Then a step S87 obtains the current time from the aforementioned timer (not shown) and obtains the time required for the process based on the difference from
25 the time obtained in the step S82. Then a step S88 compares such required time with a predetermined

reference time, thereby discriminating whether predetermined performance is achieved. If achieved, the present service evaluating process is terminated.

If the predetermined performance is not achieved, 5 the sequence proceeds to a step S89, which calls a service transfer instructing operation in order to introduce, to the client, a service provided by the own apparatus as a substitute for the service of the other, not achieving the predetermined performance, whereupon 10 the present service evaluating process is terminated.

When the above-mentioned service transfer instructing operation is called, the lookup server 14 sets the identification information of the designated transfer service, as a substitute attribute in the 15 record of the corresponding service in the management table 1801 shown in Fig. 12.

As in the foregoing sixth embodiment, the CPU 2501 of the lookup server 14 of the present embodiment executes a response process for the substitute object 20 obtaining request as shown in Fig. 20, upon receiving the request for downloading the service proxy object from the client shown in Fig. 20.

In the present sixth embodiment, as explained in the foregoing, each of the paired dispersed object 25 environment-adapted image input/output apparatuses 12 mutually tries the services of the other and, in case of the detection of a loss in the service performance

of the other, the lookup server 14 can be promptly so instructed as to transfer the request of the client for a service of the other to a service of the own side. In case such loss in the performance indicates an 5 abnormality in the service of the other, there can be obtained advantages similar to those in the fifth embodiment. Also in case such loss in the performance is a normal behavior resulting from the concentration of loads, the request for the service of the other 10 which is under a highly loaded situation can be shifted to the service of the own side whereby the loads can be dispersed between the paired apparatuses and a very simple load balancing can be realized in a simple manner. In the latter situation, the service of the 15 other sooner or later renews the registration in the lookup server 14 prior to the expiration of the lease term, whereupon canceled is the setting for transfer to the substitute service.

The performance of the service of the other 20 apparatus may be evaluated not only by the latest response time but also by the history of past several results, or by the average thereof, or by the best and worst values.

Seventh embodiment

25 Fig. 22 is a flow chart showing the sequence of a service evaluating process in a seventh embodiment of the present invention, executed respectively by each of

the CPU's 123 of the dispersed object environment-adapted image input/output apparatuses 12, on the service of the other of paired apparatuses. The CPU 123 evaluates the quality of the service of the other apparatus by periodically repeating the present service evaluating process by a timer process based on a timer (not shown).

For the purpose of simplicity, the present embodiment deals, among the services provided by the dispersed object environment-adapted image input/output apparatuses 12, with the printing service of providing the client with the printing function. The process of the present flow chart is executed, by a time-shared process of the CPU 123 of the dispersed object environment-adapted image input/output apparatus 12, parallel to other processes required in the apparatus. The process of the present flow chart is executed as a pseudo client in the dispersed object environment-adapted image input/output apparatus 12, utilizing the services of the other image input/output apparatus 12.

When the service evaluating process is started, a step S91 obtains the service proxy object 713 of the other from the lookup server 14. The service proxy object 713 is downloaded in the same manner as in the process of the ordinary client.

Then a step S92 calls a state obtaining operation from the interface 715 of the service proxy object 713,

thereby obtaining the dynamic state information of the printer. Then a step S93 evaluates the state information obtained in the preceding step S92, based on a predetermined algorithm. Such algorithm can be 5 defined by an evaluation function of a wide sense, providing a significant negative point for example for a case of exhaustion of the color toner or ink in a color printer, and a negative point for exhaustion of a large-sized printing sheet in a large-sized printer.

10 A next step S94 compares the result of evaluation (for example a negative point) in the above-mentioned step S93 with a predetermined reference value thereby discriminating whether a predetermined evaluation is obtained. If obtained, the present service evaluating 15 process is terminated.

On the other hand, if the predetermined evaluation is not obtained, the sequence proceeds to a step S95 which calls a service transfer instructing operation of the lookup server 14 in order to introduce a service 20 provided by the own apparatus to the client, as a substitute for the service of the other apparatus, failing to provide the predetermined evaluation, and the present service evaluating process is thereafter 25 terminated.

When the above-mentioned service transfer instructing operation is called, the lookup server 14 sets the identification information of the designated

transfer service, as a substitute attribute in the record of the corresponding service in the management table 1801 shown in Fig. 12.

In the present seventh embodiment, as explained in the foregoing, each of the paired dispersed object environment-adapted image input/output apparatuses 12 mutually tries the services of the other and, in case of the detection of a loss in the practical quality of the service of the other by a dynamically changing state (in particular by the shortage of a consumable resource in the apparatus), the deletion of the registration of the abnormal service can be promptly notified to the lookup server 14. It is thus rendered possible to shorten the time of continued registration of an ineffective service in the lookup server 14 and to reduce the danger that the client tries to utilize an ineffective service.

Other embodiments

The present invention may be applied to a system consisting of plural equipment (for example a host computer, an interface device, a reader, a printer etc.) or to an apparatus consisting of a single equipment (for example a copying apparatus or a facsimile apparatus).

Also the objects of the present invention can naturally be attained by supplying a system or an apparatus with a recording medium (memory medium)

5 storing program codes of a software realizing the functions of the aforementioned embodiments and reading and executing the program codes stored in the recording medium by a computer (or a CPU or an MPU) of the system or the apparatus.

10 In such case, the program codes themselves read from the recording medium realize the functions of the aforementioned embodiments, and the recording medium storing the program codes constitutes the present invention.

15 The recording medium storing the program codes and also variable data such as a table can be, for example, a floppy disk (FD), a hard disk, an optical disk, a magneto-optical disk, a CD-ROM, a CD-R, a magnetic tape, a non-volatile memory card (IC memory card) or a ROM.

20 The present invention includes not only a case where the functions of the aforementioned embodiments are realized by the execution of the program codes read by the computer but also a case where an operating system or the like functioning on the computer performs all or a part of the actual process according to the instructions of such program codes whereby the functions of the aforementioned embodiments are realized by such process.

25 In the directory server of the network system based on the dispersed objects, as explained in the foregoing, the present invention allows to transmit, to

the client, not only the information provided from the registered service but also the information indicating the level of recommendation for the service, obtained by the directory server itself by trying and evaluating 5 the registered service, thereby providing a directory server enabling the client to easily select the optimum service.

Also in the network system based on the dispersed objects, the present invention relies not only on the 10 information provided from the registered service but also causes the grouped apparatuses continue to mutually try and evaluate the services, thereby allowing to automatically eliminate, from the directory server, the registration of the service which becomes 15 ineffective relatively early without notification.

Furthermore, in the system including a plurality of equivalent services, the present invention allows the client to automatically select a service substituting a failed service in a manner equivalent to 20 the client, thereby providing the apparatus adapted to the dispersed object environment, capable of enjoying the benefit of the usability improved by the redundant configuration, without complicating the process of the client.

25 Furthermore, the present invention provides the apparatus adapted to the dispersed object environment capable of realizing simple load dispersion (load

balancing) based on the redundant configuration.

Furthermore, the present invention enables switching to the substitute service based on the dynamic state change in the apparatus such as 5 exhaustion of toner or recording sheet, thereby providing the apparatus adapted to the dispersed object environment, realizing the redundant configuration capable of coping with the deterioration in the practical quality of the provided services.

10